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PROCESS FOR T HE PRODUCTION OF BEER WITH A REDUCED LOW OR NO ALCOHOL CONTENT

Abstract:

Abstract of GB1447505

1447505 Reverse osmosis LOWENBRAU MUNCHEN 26 July 1973 [4 Sept 1972 4 May 1973] 35737/73 Heading B1X [Also in Division C6] A beer with reduced or no alcohol content suitable for consumption by patients with liver disease or diabetes is obtained by diluting fermented beer, and removing a water/alcohol mixture therefrom by subjecting the diluted beer to reverse osmosis using membranes which are permeable to the alcohol and water con- stituents of the beer only. The water used to dilute the beer should be of not greater than 8 degrees of German hardness and is most suit- ably obtained by subjecting the water/alcohol mixture extracted from the diluted beer to a further reverse osmosis to extract the alcohol in whole or in part, but other water, for ex- ample water acidified by addition of acid or acid salts such as lactic acid bacteriologically produced, water treated with weakly or strongly acid cation exchangers, natural mineral water or demineralised water, or water obtained by distillation may also be used. Membranes for the reverse osmosis and for any further alcohol extraction stage are suitably of aminated poly- amide, cellulose acetate, nylon or 98% hydro- lysed polyvinyl acetate. The quality of the product may be adjusted by the subsequent addition of water or beer. Data supplied from the esp@cenet database - Worldwide

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(54) PROCESS FOR THE PRODUCTION OF BEER WITH A REDUCED, LOW OR NO ALCOHOL CONTENT

(71) We, "LÖWENBRAÜ" MÜNCHEN, a body corporate organised under the laws of the Federal Republic of Germany, of 4 Nymphenberger Strasse, Munich, Germany,

do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to a process for the reduction or elimination of the alcohol content of beer.

Great interest has been shown for a long time in full-bodied beers with a low or no alcohol content, especially by motorists and persons for whom, on health grounds, such as with liver complaints, the enjoyment of alcohol is largely forbidden. This fact is reflected in the large number of manufacturing processes which have been proposed for beers having a low or no alcohol content. Thus, attempts have been made to remove the alcohol from beers by different types of distillation methods, typical examples being the evaporation methods disclosed in Offenlegungsschrift 1,442,238 and Auslegeschrift 1,266,266. In other methods, fermentation is stopped by pasteurisation or sterilisation of the initially fermented beers. In addition, various fermentation exciters such as Saccharomycodes Ludwigii have been proposed. The latter does indeed ferment glucose, fructose and saccharose, but not maltose.

There are, however, serious defects in all these processes.

The so-called distillation processes necessitate very costly and involved equipment and, because of the use of increased temperature at which conversions of the taste and aroma carriers are initiated or oxidation phenomena and so on occur, the resulting product is not very satisfactory, particularly from the point of view of taste. Moreover, processes which involve stopping the fermentation, which processes, because of the required final low alcohol content, must operate with low original wort contents, lead to beers which are not thoroughly matured and which are frequently found to be tasteless. Attempts to eliminate the immature taste of the beers obtained by the said processes by using adsorption agents, such as silicon dioxides, bentonites and active carbon, do not have the required effect.

According to the present invention there is provided a process for the production of a beer with a reduced or no alcohol content comprising, diluting normally fermented beer by adding water at a proportion according to the required alcohol content of the final product beer, and extracting a water and alcohol mixture therefrom by means of reverse osmosis, using membranes which are permeable to the alcohol and water constituents of the beer only.

It is known to provide pure and ultra-pure water for industrial purposes by means of reverse osmosis (e.g. as disclosed in Auslegeschrift 1,517,915) whereas, when using a water/concentrated salt solution system, for example, osmosis allows the water to penetrate through a semi-permeable membrane into the concentrated salt solution in reverse osmosis, a pressure which is above the osmosis pressure of the solution is applied to the concentrated salt solution. In the present invention, a certain pressure is thus exerted on the beer, which pressure, when using a suitable membrane, only permits a pure alcohol-water mixture to diffuse from the beer through the membrane. The substances providing the taste and aroma, as well as the other constituents of the beers, are thus fully retained.

The reverse osmosis is normally carried out at a temperature of about 0°C at a pressure on the beer side of 30—50 atm., the inlet pressure being about 2 to 5 atm., and the discharge pressure being 2 to 4 atm.

The invention further consists in extracting alcohol and water from a finished fermented beer or a young beer by subjecting an initial beer product diluted with water to reverse osmosis. In this case, water is added to the

finished fermented beer or the young beer before the treatment by the reverse osmosis. The amount of water which is added is determined by the required alcohol content of the finished product. This quantity of water can be equal to the quantity of the initial beer, but it can also be greater or less.

Another feature of the invention consists in extracting from the beer by reverse osmosis a certain quantity of alcohol and water which is determined by the required alcohol content and the required extract content of the final product beer.

If the membrane being used for water and alcohol is almost uniformly permeable, the alcohol content, once adjusted by the addition of water to the beer to be treated, is the same for the beer product which is obtained by the reversed osmosis process and for the alcohol/water mixture which is separated out. The alcohol content can additionally be influenced by using membranes with other permeability values.

The required alcohol content extracted can be influenced, because the stronger the alcohol/water mixture extracted from the beer being treated, the greater will be the reduced alcohol content in the final product beer.

The invention results in various advantages. The higher in fact is the extract alcohol/water content of a beer, the greater is the danger of important constituents which determine the taste, smell and keeping qualities being separated out and lost with the alcohol/water. Therefore, particularly good results are to be obtained when using diluted beers. Furthermore, the life of the membrane is increased, for a diluted liquid prevents the danger of the membrane and the conduits becoming clogged.

If the process is carried out in such a way that the same volume of liquid is extracted by the reverse osmosis as water is previously added, the following advantages are obtained:—

1. The quantity of the alcohol-reduced beer is equal to the quantity of the undiluted and formerly introduced original beer;
2. the extract content of the beverage which is obtained is identical with the extract content of the original beer in quality and quantity;
3. the beer obtained directly from the plant differs only from the original beer by having a lower alcohol content.

It is obviously also possible to produce an alcohol-reduced beer, which has a higher or lower extract content than the original beer by appropriately regulating the equipment. However, by comparison with the original beer, there is obtained for the alcohol-reduced beer a concentration (smaller resulting quantity) or a dilution (larger resulting quantity), which ultimately was caused by the originally added water.

According to another feature of the invention, the water added to a finished fermented or young beer before the reverse osmosis treatment or to a beer from which alcohol and water mixture has been extracted by the reverse osmosis treatment is water of a particular type.

For the taste and smell of a manufactured beer, all the constituents of the beer are important. Initial tasting, judging and drinking are not only the function of certain individual constituents of the beer, but are due to the coaction and the mutual influencing of different substances. Depending on the relative ratio of individual substances in the extract from the initial such as albuminous substances, dextrins, gum bodies, tannin principles and, bitter principles, the initial tasting of a beer can be sensed as being soft with good body or flat with good body. The judging of a beer depends to a high degree on the pH value, as does the effect after drinking, which is predominantly characterised by its bitters, the influence of mineral substances also playing a part. The overall impression of the beer is then rounded off when the individual taste-forming agents harmonize with one another and merge into one another. The addition or the removal of constituents of the beer can disrupt this harmony, with the effect of reducing the quality of the beer.

Therefore, according to a preferred feature of the invention, water of a defined pH value and a predetermined salt ion concentration may be added to the beer either before or after the reverse osmosis treatment. Preferably, the water added has a predetermined salt ion concentration and a pH value which varies by no more than 1.0 pH units from a predetermined value.

In the event of unsuitable water being used, the pH value of the beer can as a consequence be decisively altered. This leads to displacements in the dissociation of aromatic substances and thus to a change in their organoleptic nature and intensity. For example, at higher pH value, acetoin is more strongly dissociated and consequently more active as regards taste. This fact applies particularly for beer constituents with hydroxyl, carbonyl, carboxyl and sulphydryl functional groups. Most of the bitter principles also belong thereto. A beer with a mild fragrant aroma and a pH value of 4.5 can be given a strong, rough and inferior taste by raising this value, due to the dissociation.

The influence caused by certain salt ions can also be disadvantageous. Magnesium carbonate makes the beer rough and coarse in the bitters, and a high content of sodium sulphate or magnesium sulphate can also produce a base and rough bitter taste. Calcium chloride, sodium chloride and calcium sulphate can increase the good body of the beer. On the other hand, an excessive increase of calcium

ions in the beer leads to clouding due to oxalate.

Albumins are of outstanding importance as regards the taste of the beer, the formation and the lasting qualities of the froth and the chemicophysical stability. A shift in the hydrogen ion concentration leads to precipitations and to a clouding of the beer, due to reaching the isoelectric point of different protein fractions. The same effect is achieved by raising the salt ion concentration of the beer, more particularly by means of magnesium sulphate and aluminium sulphate, due to a dehydration of proteins. The consequence arising from this is that the good body of the beer suffers, the bitter substance is less satisfactorily balanced out and becomes obtrusive, and the froth formation and the keeping qualities thereof are substantially reduced by disturbing the colloidal structure.

To obtain a product having the quality of normal beer, specially prepared water or certain natural water is used when producing alcohol-reduced beer from new beer or fully matured fermented beer by the reverse osmosis process of the invention. It is necessary to use a water having a pH value of the starting beer (e.g. 4.5). With waters which contain salts, the pH value consequently has to be adjusted by addition of an acid or acid salt, such as sulphuric acid or lactic acid, or of gypsum or calcium chloride. A water acidified by lactic acid produced bacteriologically can also be used. Munich tap water (total hardness of about 16° German hardness) can be brought to the required pH value by using a weakly acid or strongly acid cation exchanger, by the extraction of the calcium and magnesium ions which cause the carbonate hardness of all cations and possibly subsequent treatment by a carbon dioxide trickle-type gas extractor. This process is already carried out for producing soft brewery waters. Acid, natural mineral waters can be used without further preparation, provided that their hydrogen ion concentration is the same as or similar to that of the beer.

In addition, waters which are almost completely demineralised and which have been obtained by distillation, ion exchange or reverse osmosis can be used. In such cases, no correction of the pH value is necessary, since the pH value of the water is neutral.

The salts of the introduced waters become for the major part beer constituents, because of the dilution before or after the reverse osmosis. The best possible results are consequently obtained with deionised waters or with soft waters of which the total hardness is below 8° German hardness.

Another feature of the invention consists in partially or completely extracting the alcohol from the alcohol/water mixture obtained from the reverse osmosis process and adding the water or dilute alcohol solution which is obtained to the beer for dilution purposes before the reverse osmosis or for redilution after the reversed osmosis.

The alcohol/water mixture obtained from the reverse osmosis can be freed from alcohol by distillation. In this case, practically pure alcohol is formed; the azeotrope with water boils at 78.17°C (normal pressure) and contains 96% alcohol. With the process of vacuum distillation, the same result can be achieved at a low, and hence safer temperature. A substantial extraction of alcohol can also be achieved in a particularly advantageous manner by the reversed osmosis process. For this purpose, membranes of hydrolysed polyvinyl acetate from, which 98% of the acetyl groups have been removed by hydrolysis are suitable. In this case, practically pure water diffuses through the membrane and almost pure alcohol is separated out.

The process wherein the water added is obtained from the water and alcohol extracted from the beer by reverse osmosis has the following advantages:—

1. the process can operate entirely continuously;
2. an addition of water to the beer is unnecessary;
3. 96% alcohol is recovered; and
4. low molecular weight constituents, which may have entered the alcohol/water mixture, are returned again to the beer.

This process thus provides best possible conditions for the manufacture of high-quality, alcohol-reduced beer. The known process of direct distillation of finished fermented beer is inferior to the invention, more particularly as regards the quality of the alcohol-reduced beer. Due to the use of raised temperatures, important taste and aroma constituents are converted and disadvantageously influenced. Important proteins, which are essential for froth formation, for the keeping qualities and from the point of view of taste are lost to the beer.

Using the preferred process of the invention, firstly an alcohol/water mixture is extracted from the beer at temperatures from 0—5°C by the reverse osmosis process and this mixture is thereafter distilled for recovering the water or, better still, is subjected to a special reverse osmosis process. If in special cases there are in the alcohol/water mixture traces of low molecular weight beer constituents (molecular weight up to about 200), such as mineral substances, amino acids, etc., the influence of temperature is unimportant. By complete contrast therewith, when using the direct distillation of a beer, the influence of temperature on high molecular weight albumins (molecular weight up to about 100,000), high molecular weight dextrins and so on is of quite decisive importance.

Among the wide selection of membranes,

aminated polyamide membranes, cellulose acetate membranes and the nylon membranes have proved to be particularly suitable for the extraction of water and alcohol from beer by the reverse osmosis. The pH stability range of these membranes lies between 2 and 8. Beers of which the pH is known to fluctuate within the range 4 to 5 can be treated with these membranes. The cellulose acetate and nylon membranes also guarantee that all important constituents of a beer, such as the different types of sugar, albumins, taste and aroma substances, colouring agents and mineral salts, are in practice completely retained and that, as required, only an alcohol-water mixture passes through the membrane. Aminated polyamide membranes have a different permeability for water and alcohol. By the extraction of this alcohol-water mixture, there is formed a product which, by dilution with water or even better by blending with a normally fermented draught beer (2 to 5.5% original wort), can be adjusted to the required alcohol content and the original or required original wort content. A circumstance which is of decisive importance is that, in beer of low alcohol content produced according to the invention, apart from the reduced alcohol content, all constituents of a full-body beer are completely retained without any changes. Since the procedure takes place in a closed system and a carbon dioxide atmosphere, it is impossible to have any undesired absorption or oxygen which is harmful to the beer.

The necessary system pressure can be generated by piston pumps with expansion chamber operation. The discharge pressure is 2 to 4 atm. and in this way prevents a dissociation of carbon dioxide and froth development in the beer. These three pressure phases in the values as indicated have proved to be particularly advantageous for a gentle extraction of alcohol and for maintaining the taste and aroma of the treated beer. The indicated counteracting pressure, which applies a load on the beer side according to the invention, additionally has the effect that the froth-keeping quality and carbon dioxide content are substantially maintained. Small losses of carbon dioxide can easily be cancelled out again by carbonisation after the blending. The efficiency of a reverse osmosis installation can be increased as desired by using an increased number of membranes. In this way, the said process is particularly economic as compared with the distillation processes, since the economy can also be increased with the size of the installation. The particular economy obtained by the reverse osmosis installation is also due to the low energy demand, the low demand for chemicals for cleaning and disinfection and the low cost for maintenance and labour.

An embodiment of the present invention will now be described, by way of example, with reference to the figure of the accompanying drawing, which is a diagrammatic view of an embodiment of an apparatus for carrying out the process of the invention.

With reference now to the apparatus shown in the Figure, a full bodied new beer is fed from a chamber 1 to a reverse osmosis treatment chamber 2. The treated beer with a reduced alcohol content is fed directly to a collecting chamber 7 while an alcohol/water mixture formed by the reverse osmosis treatment is fed *via* a pipe 3 to a distillation chamber 4. Water is recovered from the distillation of the mixture in chamber 4 and is recirculated *via* a pipe 6 to be added to the new beer entering the reverse osmosis chamber 2. Alcohol which is extracted from the mixture in the distillation chamber is fed to a storage chamber 5. In this first phase of the process the alcohol content of the new beer is reduced and the water recovered from the distillation process is recirculated and used to dilute the supply of new beer before it is subjected to the reverse osmosis treatment.

The process operates continuously and can be controlled in a fully automatic manner. The extraction of alcohol from the beer can be advanced by series connection of membranes until the beer obtained is practically free from alcohol.

The process according to the invention can also be used with high fermented diet beers for diabetics, so that those diabetics for whom the consumption of beer would otherwise be prohibited because of the high alcohol content (about 5% by weight) are able to drink beer.

Using the process according to the invention, it is furthermore possible to produce a low alcohol full-body beer (11—14% original wort) fully satisfactory as regards taste from a normally fermented draught beer (7—8% original wort), in which case there is no re-dilution and no blending of the beer concentrate. A low alcohol draught beer can also be produced in the same way.

Various examples of application are now set out below, in order to indicate how different kinds of beer can be treated according to the invention. In all examples the reverse osmosis is carried out at a temperature of about 0°C, an initial pressure of 2 to 5 atm., a system pressure on the beer side of 30 to 50 atm. and a discharge pressure of 2 to 4 atm.

Furthermore, the carbon dioxide content of the treated beer can be brought by post-carbonisation to the original content of the initial beer, and it is possible for the treated product to be blended, for example with full-body beer or "heads", in order subsequently to raise the alcohol content somewhat, if desired.

One manner of performing the invention is to extract by reverse osmosis a quantity of water and alcohol mixture from the diluted beer which is equal to the quantity of the un-

diluted beer so that the extract content of the final product beer is equal to the extract content of the undiluted beer.

Example 1

A light full-body beer having an alcohol content of 3.8% by weight, an extract conten of 4.4% by weight (original wort content of 11.8% by weight) and 5.0 g of carbon dioxide per litre has added to it the same volume of water. There is produced in the mixture an alcohol content of 1.9% by weight and the extract content becomes 2.2% by weight. The product thus produced is subjected to reverse osmosis in an osmosis cell containing cellulose acetate membranes in such a way that the ratio between the volumes of the alcohol-reduced beer being formed and the alcohol/water mixture amounts to 1:1. (Initial pressure 2.5 atm., system pressure 35 atm., counter-pressure 2 atm.). An alcohol/water mixture having an alcohol content of 1.9% by weight is extracted from the diluted beer and the result is an alcohol-reduced beer with an alcohol content of 1.9% by weight, while the extract content, at 4.4% by weight, corresponds to the extract content of the original beer.

Example 2

As in Example 1: Full-body beer with an alcohol content of 3.8% by weight and 4.4% by weight extract content has added thereto 1.7 times the volume of water to provide a diluted beer having alcohol content of 1.4% by weight, and an extract content of 11.6% by weight. The alcohol/water mixture extracted as a result of the reverse osmosis has an alcohol content of 1.4% by weight and is in a ratio by volume of 1.7:1 to the forming alcohol-reduced beer. The beer which is obtained consequently has an alcohol content of 1.4% by weight and an extract content of 4.4% by weight.

(a) A part of this beer i.e. (A; 1.4% by weight; E_w: 4.4% by weight) is blended with 0.3 part by wt. of the original beer. In this way, there is produced a beer with an alcohol content of 1.95% by weight, while the extract content remains constant at 4.4% by weight.

(b) Another part of this beer was blended with 0.118 part "heads" so that, after fermentation, there was produced a beer having about the same alcohol content and extract content as in (a).

Example 3

The procedure of Example 1 was followed using the following beers:—

(a) Light Export (beer: water dilution ratio=1:0.70 by volume)

	Initial beer	Diluted beer	Alcohol/water mixture	Alcohol reduced beer (non-extracted portion)
Extract, % wt.	4.67	2.7	—	4.6
Alcohol, % wt.	4.35	2.6	2.6	2.6
Original wort, % wt.	13.07	—	—	—

(b) Hellquelle (beer:water dilution ratio=1:0.80 by volume)

Extract, % wt.	4.4	2.5	—	4.4
Alcohol, % wt.	3.9	2.1	2.1	2.1
Original wort, % wt.	12.0	—	—	—

(c) Pils (beer:water dilution ratio=1:0.90 by volume)

Extract, % wt.	5.0	2.7	—	4.9
Alcohol, % wt.	3.3	1.7	1.7	1.7
Original wort, % wt.	11.4	—	—	—

(d) Pils (beer:water dilution ratio=1:0.85 by volume)

Extract, % wt.	4.5	2.4	—	4.4
Alcohol, % wt.	3.7	2.0	1.9	2.0
Original wort, % wt.	11.7	—	—	—

(e) Diet (beer:water=1:0.56)

Extract, % wt.	1.9	1.2	—	1.7
Alcohol, % wt.	5.0	3.2	3.2	3.2
Original wort, % wt.	11.6	—	—	—

For producing alcohol-reduced beers, it is possible to start not only with a normally fermented beer, but also with young beer. The fermentation in this case is prematurely stopped by extracting the yeast, alcohol is extracted by the reverse osmosis and finally, by adding yeast or heads, the beer is fermented to a discharge fermentation degree and simultaneously matured over several weeks.

Example 4

Young beer with an original wort of 11.6% by weight, an effective degree of fermentation of 50% and correspondingly about 5.8% by weight extract content and 2.9% by weight alcohol, is stopped in its fermentation by extracting the yeast by means of filtration. The beer has added thereto 1.2 times the volume of water and is subjected to reverse osmosis in a manner which produces a product with an alcohol content of 1.3% by weight and an extract content of 5.8% by weight. By adding yeast, the beer is further fermented. The extract content is then found to be 4.2% by weight, the alcohol content increasing by 0.8% by weight. After filtration, an alcohol-reduced fully-body beer is produced with an extract content of 4.2% by weight and an alcohol content of 2.1% by weight.

Example 5

As Example 4, but heads and not yeast are added to the alcohol-freed new beer and the beer is then fermented to the required alcohol content.

Example 6

New beer with an alcohol content of 4% by weight and an extract content of 4.4% by weight is subjected to reverse osmosis, so that there is produced firstly a beer with 4% by weight alcohol and 8.8% by weight extract, and secondly an alcohol/water mixture with 4% by weight alcohol in equal volumes. 96% alcohol is now extracted from the alcohol/water mixture by distillation and the water which remains is added to the original initial beer. In the first phase, there is formed an alcohol/water mixture with 4% by weight alcohol, and by the immediate dilution of the initial beer, the alcohol content then falls spontaneously to 2% by weight and remains constant. As a whole, there is in this way once again obtained an alcohol-reduced beer with an alcohol content of 2% by weight and an extract content of 4.4% by weight.

For carrying out the reverse osmosis process according to the invention, there are more particularly to be considered the following membranes as known *per se*:

aminated polyamide membrane,
cellulose acetate membrane,
nylon membrane,
hydrolysed polyvinyl acetate membrane in which 98% of the acetyl groups have been removed by hydrolysis.

The first-mentioned membrane had different permeability for water and alcohol.

WHAT WE CLAIM IS:—

1. A process for the production of a beer with a reduced or no alcohol content comprising, diluting normally fermented beer by adding water at a proportion according to the required alcohol content of the final product beer, and extracting a water and alcohol mixture therefrom by means of reverse osmosis, using membranes which are permeable to the alcohol and water constituents of the beer only.

2. A process according to Claim 1, in which the quantity of water added is equal to the quantity of undiluted beer to be treated by reverse osmosis.

3. A process according to Claim 1, in which the quantity of water added is greater than the quantity of undiluted beer to be treated by reverse osmosis.

4. A process according to Claim 1, in which the quantity of water added is less than the quantity of undiluted beer to be treated by reverse osmosis.

5. A process according to Claim 1, in which the quantity of the water and alcohol mixture extracted from the diluted beer by the reverse osmosis treatment is equal to the quantity of the undiluted beer so that, the extract content of the final product beer is equal to the extract content of the undiluted beer.

6. A process according to Claim 1, in which the water added to the beer is water which has been obtained from the water/alcohol mixture by removal therefrom of the alcohol.

7. A process according to Claim 1, wherein the reverse osmosis is carried out at a temperature of about 0°C, an initial pressure of 2 to 5 atm., a system pressure on the beer side of 30 to 50 atm. and a discharge pressure of 2 to 4 atm.

8. A process according to Claim 1 or 2, in which water is added to the beer after the reverse osmosis treatment.

9. A process according to Claim 1 or 2, in which normally fermented draught beer is added to the beer after the reverse osmosis treatment.

10. A process according to any of Claims 1 to 9, in which water is added to the beer either before or after the reverse osmosis treatment and in which the water added has a predetermined salt ion concentration and a pH value which varies by no more than 1.0 pH units from a predetermined value.

11. A process according to Claim 10, in which water acidified by an acid is used.

12. A process according to Claim 10, in which the added water is acidified by acid salts.

13. A process according to Claim 10, in which the added water is biologically acidified by lactic acid bacteriologically produced.

14. A process according to Claim 10, in which water prepared by means of a weakly acid cation exchanger.

15. A process according to Claim 10, in which water prepared by means of a strongly acid cation exchanger is used.

16. A process according to Claim 10, in which demineralised water is used.

17. A process according to Claim 16, in which the water is obtained by means of distillation.

18. A process according to Claim 10, in which natural mineral water is used.

19. A process according to Claim 1 in which the total hardness of the water is not higher than 8 degrees German hardness.

20. A process according to Claim 10, in which water obtained from the alcohol and water extracted from the beer by the reverse osmosis treatment is added.

21. A process according to Claim 20, in which alcohol is extracted from the alcohol/water mixture which is extracted from the beer by reverse osmosis treatment and the remaining water is added to dilute the undiluted beer prior to the reverse osmosis treatment or to a beer treated by reverse osmosis.

22. A process according to Claim 21, in which alcohol is only partially extracted from the alcohol and water mixture.

23. A process according to Claim 21 or 22 in which the alcohol and water mixture is subjected to a distillation under normal pressure.

24. A process according to Claim 21 or 22, in which alcohol and water mixture is subjected to a vacuum distillation.

25. A process according to Claim 22 or 24 in which alcohol is extracted from the alcohol and water mixture by reverse osmosis treatment.

26. A process according to any of Claims 1 to 25 which is carried out continuously.

27. A process according to any of Claims 1 to 26 in which an aminated polyamide membrane is used for carrying out the osmosis.

28. A process according to any of Claims 1 to 26 in which a cellulose acetate membrane is used for carrying out the reverse osmosis treatment.

29. A process according to any of Claims 1 to 26, in which a nylon membrane is used for carrying out the reverse osmosis treatment.

30. A process according to any of Claims 1 to 26 in which a hydrolysed polyvinyl acetate membrane is used for carrying out the reverse osmosis treatment.

31. A process according to Claim 25, in which a membrane of hydrolysed polyvinyl acetate is used for the extraction of alcohol, and in which polyvinyl acetate 98% of the acetyl groups have been removed by hydrolysis.

32. A process for the reduction or elimination of the alcohol content of a beer and substantially as herein described.

33. An apparatus for carrying out the process according to Claim 1 substantially as herein described with reference to the Figure of the accompanying drawings.

34. Beer produced by the process of any of claims 1 to 32.

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1447505 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*